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I. SUMMARY

1. The issue paper highlights the basic role of the building materials industry in the development process. It emphasizes the crucial importance of this industry to any economic development strategy since gross fixed capital formation takes place, to a large extent, in the form of construction work for which building materials constitute a major input.

2. In spite of a considerable increase in the production of building materials in developing countries, the growth of that industry has been lagging behind the growth of construction activities and this has led to an escalation of imports since 1970. Since even the gloomiest projections for growth in per capita GNP in developing countries indicate that domestic demand for building materials will at least double by 2000, the situation is unlikely to improve if present trends are allowed to continue.

3. On the basis of this, it is argued that there is a need for active measures to promote this industry in the developing world. Planning is essential given the long lead times involved in setting up production facilities for most building materials. Also, a major influence on the development of the sector was found to be the production scale of plants. The paper contends that socio-economic conditions in many developing countries favour the adoption of small-scale over large-scale plants.

4. On the basis of these points of analysis, the Consultation is requested to deliberate on the:

- Needs to be satisfied by the building materials industry in developing countries;
- Constraints to the development of the building materials industry;
- Measures of international co-operation to overcome those constraints.

5. The "Points for discussion" proposed to the Consultation are included in para.36 of this paper.

II. THE CRITICAL ROLE OF THE BUILDING MATERIALS INDUSTRY IN CONSTRUCTION AND ECONOMIC DEVELOPMENT

6. The problem of fixed capital formation is at the centre of any economic development policy. In industrialized economies capital formation tends to require a higher proportion of machinery and equipment than in countries with a poorly developed economic infrastructure which require a greater part of capital formation to take the form of construction works like residential and non-residential buildings, roads, bridges, dams, irrigation, land reclamation and canalization works, water supply, sewages, airport and harbour facilities, etc. It has been estimated that construction usually accounts for over 50 per cent of the total gross fixed capital formation (GFCF) in developing countries. This share tends to decline with higher levels of industrialization. 1/ *

7. Building materials are the most important input to the construction sector. Surveys in a number of developing countries show that the intermediate consumption of materials and supplies range from 37 per cent to 55 per cent of the total value of construction output. 2/ Thus, the building materials industry constitutes a critical prerequisite to the development of construction activities and of development in general. Experience in developing countries over the last few decades has shown that the lack of adequate development of this sector can lead to considerable delays in the implementation of development projects. Moreover, foreign exchange constraints due to high foreign indebtedness and slack exports impose severe external limitations to the development prospects of a great number of developing countries. In this context, due to its potential for import substitution, and its role in development, this sector constitutes a priority target for any national policy aimed at satisfying the needs of the population and decreasing import dependency.

Building materials industry

8. The economic contributions of the building materials industry cannot be separated from the construction industry which consumes its products. However, only a few industries produce exclusively for the construction sector. For example, this is the case in the production of cement and bricks.

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* Notes are provided at the end of this paper.

However, in the case of the wood industry, the construction sector in developed countries consumes more than 50 per cent of the total production of sawnwood and wood-based panels. 3/ For the iron and steel industry construction represents 42 per cent of total steel usage in the USA 4/ and around 50 per cent in the developing countries of Asia and Far East. 5/ Because the output from these industries is also used by other sectors of the economy, factors other than trends in the demand of the construction sector may shape these industries' growth and vitality.

International pattern and past trends in production and consumption of the building materials industry

9. Construction activity constitutes the outlet for building materials and as such indicates trends in demand for building materials. The value added in the construction sector is very unevenly distributed between developed and developing countries. In 1980, 74 per cent of the world population lived in developing countries, but they generated only 20,5 per cent of the world's gross domestic product and accounted for around 18 per cent of the world's construction value added. 6/ This was despite a period of high growth rates in developing countries, when both construction and GDP increased at significantly higher rates than in developed countries.

10. Trends of the growth rates of construction activity differ among geographical regions. In Africa, the growth in construction rose sharply from an average of 2.2 per cent annually in the early 1960s to 12.6 per cent in the mid-1970s, but fell to 7.9 per cent in 1978-80. Latin America and the Caribbean experienced their peak growth rates in the early 1970s with 8 per cent annually, but then declined steadily to 6.5 per cent in 1978-80. Construction growth in Asia reflects the oil boom and its impact on infrastructure and building investment in the Middle East and the rapid industrialization in the Far East in the 1970s.

Table 1

Average annual growth rates in GDP, industry and construction in developed and developing market economies

	1960/65	1965/70	1970/75	1975/80
Developed market economies				
- GDP	5.3	4.9	3.2	2.8
- Industrial activity	6.3	5.4	2.5	3.3
- Construction	6.2	3.7	0.8	0.5
Developing market economies				
- GDP	5.5	6.3	6.3	5.3
- Industrial activity	8.6	8.8	6.6	4.4
- Construction	4.9	7.2	8.3	9

Source: UN-Yearbook of National Accounts Statistics, 1981.

11. The production of building materials in developing countries has, however, been lagging behind the growth of construction activities. As can be seen from the figures in Table 2, the growth in construction has been higher than that in the production of almost all building materials implying that these countries have had to meet the increased demand for building materials through increased imports.

Table 2

Growth rates in GDP, construction and building materials production in selected developing countries, 1975-1980

	Egypt	Kenya	S.Arabia	Thailand	Malaysia	Korea	India	China	Argentina	Mexico
Population	2.6%	4.6%	3.0%	2.5%	2.5%	1.6%	2.1%	1.4%	1.3%	3.9%
GDP	9.8%	5.7%	10.6%	8.8%	10.2%	8.8%	13.9%		2.1%	7.6%
Construction	42.1%	4.9%	13.5%	18.9%	16.3%	15.5%	12.7%		7.8%	8.3%
BLDG. MTLS PRODUCTION										
Plywood	-6.3%	3.6%		14.9%	4.3%	3.6%	8.3%	10.6%	-2.6%	26.2%
Glass						17.0%	12.5%			6.3%
Build. Bricks, clay	-8.0%	-4.0%				-5.6%				
Quicklime	1.8%		31.8%			22.0%	24.4%			
Cement	0.4%	8.5%	33.6%	7.0%	12.5%	10.9%	1.9%	14.5%	7.2%	9.3%
Asb.+ Cem. Art/s							6.6%			7.9%
Concrete blocks		116.4%				102.5%				
Cr. Steel, Ingots	32.3%			18.5%		36.8%	3.8%	11.1%	5.4%	7.0%
Angles, Shapes, etc.					8.9%	28.3%				4.5%
Aluminium						3.9%	2.0%	5.7%	101.0%	1.4%
Nails, Screws, etc.	6.8%					39.8%	0.8%			

Source: UNIDO World-Wide Study on the Building Materials Industry, 1985.

International trade

12. The construction industry in many developing countries is dependent to a large extent on imported building materials. In some countries of Africa, over 90 per cent of the value of building materials used in the formal construction sector is accounted for by imports. 7/ Table 3 indicates that the import bill of the developing countries for building materials is escalating rapidly, from US$ 6.1 billion in 1970 to US$ 49.4 billion in 1980. While developing country exports also increased during this period (from US$ 2.8 billion in 1970 to US$ 19.8 billion in 1980), the result was nonetheless a large negative balance of trade. Developing countries' net imports of building materials amounted to $US 3.3 billion in 1970; to US$ 18.2 billion in 1975; to US$ 29.6 billion in 1980; and to about US$ 35 billion in 1982. Hence, building materials represented a considerable drain on scarce foreign exchange in the developing world at precisely the time when developing countries could least afford it. In fact, a very large number of developing countries are so constrained to keep tight control over their expenditures for the import of goods and services that the importation of investment goods, including building materials, are permitted only for essential projects. Many of the other development projects can not be realized due to unavailability of foreign exchange to import the required imports.

Table 3

Trade in building materials, 1970-1980
($US million)

Origin \ Destination	Year	Developed market economy countries	Developing countries	Socialist countries EE and Asia
Developed market economy countries	1970	16.982	4.734	1.277
	1975	36.417	20.377	6.667
	1980	76.602	38.203	8.409
Developing countries	1970	1.882	800	162
	1975	3.258	2.270	480
	1980	10.385	8.450	950
Socialist countries of Eastern Europe and Asia	1970	1.047	570	n.a.
	1975	1.926	1.560	n.a.
	1980	3.881	2.720	n.a.

Source: UNCTAD 8/

Long-term prospects for construction and constraints to the development of the building materials industry

13. Irrespective of the prospects for the recovery of the world economy, the evolution of world prices, interest rates and international debt arrangements, some trends can be sketched about the future demand for construction and building materials by various groups of countries.

14. In the developed market economies, the declining ratio of construction investment to gross fixed capital formation and also to gross domestic product observed since the sixties is very likely to continue in the future. Due to this and decreasing growth rates of population, construction is likely to grow at very low rates.

15. In developing countries the construction needs will certainly increase in the years to come if only due to the growth in population which is likely to occur. Projections indicate that the developing world's population will increase from 3,3 billion in 1980 to 4,8 billion by the year 2000,[9/] and the high urbanization rates will require additional housing and infrastructure. The question remains open as to how far the housing needs of developing countries can be satisfied in the present economic, social and political environment. It should be borne in mind that a large number of the unemployed and low-income earners are not in a position to afford even the cheapest dwellings offered on the market. [10/] A large part of these housing needs will probably be met by the informal sector. [11/] On the other side, development projects will require immense amounts of building materials to develop the industrial, transport, communication, energy and social infrastructures. The amount of resources to be spent on housing or on non-residential building and civil engineering is obviously a political choice.

16. The correlation existing between growth of GDP and construction permits a rough prediction of future demand for building materials. According to three scenarios sketched by the UNITAD model, the demand for construction and building materials will grow significantly through 1990 in all developing countries. [12/] Even the gloomiest projections for growth in per capita GDP in developing nations indicate that domestic demand for building materials will at least double by the year 2000. [13/]

17. In order to meet this demand, developing countries will have to take measures to overcome the constraints which hamper the development of their building materials industry. The main constraints which require priority attention have been identified as follows:

- lack of long-term planning and co-ordination of development policies;
- lack of adequate financial resources;
- concentration of investment in capital intensive plants with poor project conception and inappropriate technologies;
- poor management practices and lack of skilled manpower;
- lack of adequate standardization and quality control;
- existence of outmoded building codes and regulations;
- inadequate research, technology and information infrastructure. 14/

III. THE NEED FOR PLANNING

18. It was suggested in the previous chapter that the output of building materials in developing countries is generally insufficient to satisfy demand. Building materials needs usually exceed effective demand in these countries to a great extent, and will therefore force governments to undertake deliberate policy choices on what type of demand to satisfy and with what kind of resources. In fact, if current trends are allowed to continue without any effort to overcome the imbalance between the supply and demand of building materials, the gap is bound to increase. A prerequisite to any well conceived policy decision is (a) on the demand side: an inventory and assessment of present and future needs, and (b) on the supply side: an inventory of resources.

19. The lead times involved in planning, designing and installing production facilities for building materials, especially those for cement and steel, can be as long as 5 and 10 years for conventional plants. As a consequence the ability to forecast demand accurately for the long term is necessary for planning the expansion of existing productive facilities or the installations of new ones.

20. Since almost every development action has an important construction component and a building materials demand, these activities have to be carefully catalogued in order to obtain a comprehensive assessment of building materials requirements. A first step in this direction would be to disaggregate construction demand according to its final use: housing,

non-residental building and civil engineering. [15/] A further distinction should be made between construction in the formal and the informal sector. The use of annual budgetary programmes might constitute an instrument to monitor public construction demand.

21. The importance of a well established resource inventory cannot be overestimated. In the first place, such an inventory may help to determine the extent to which the satisfaction of needs is restrained by limited natural resources and/or lack of effective demand, i.e. lack of purchasing power. In the second place a supply inventory could ascertain whether or not the demand for specific building materials could be met by the capacities of the existing industries.

22. Inventories of needs and supply will allow planners to decide on alternative end uses of the building materials (e.g. housing, infrastructure, etc.), and to define product mixes and production targets. At present, few development plans in developing countries contain target figures for construction or even point out its relationship with other sectors. In the building materials industry it is usually only cement, steel and eventually glass which figure in quantitative targets.

23. Planning is of great importance for the development of this sector in developing countries. Where indicative planning is used targets will have to be determined to co-ordinate private and public sector investment and output. Under a centralized (or directive) planning system, production and investment will have to be set on the basis of forecasts of demand and decisions on the allocation of resources. But even in countries which base their economic policy on the market forces, long-term forecasts of demand and supply inventories of resources will be necessary for promotional measures for the industry. Also, in branches which by their size are likely to have a monopolistic position, a price and location policy will be necessary (e.g. in the cement and steel industries).

24. An example of different policy instruments which could be used to promote the building materials industry can be found in the Mexican Industrial Plan for 1979. This Plan envisaged the reorientation of industrial production towards basic or essential consumer goods, the promotion of small-scale producers and the decentralization of industry as well as the employment of labour-intensive technologies. For this, the Plan identified specific

instruments, which in the case of building materials were as follows: (a) purchasing policy of the government in favour of domestic suppliers; (b) pricing subsidies on energy for new enterprises; (c) financial support to enterprises operating in priority geographical areas as well as small and medium enterprises; (d) tariff protection; and (e) tax incentives for private investment in priority areas, both sectoral and regional with the objective of encouraging higher levels of employment. 16/

IV. FINANCE

25. The most important determinant in the establishment of building materials industries by developing countries is the capital cost investments and working capital for industrial installations. For steel, the capital costs (per ton of steel) are considerable; in 1963 it was estimated that the capital cost was US$250. In 1976 the annual cost per ton of capacity installed in steel in the United States was assessed at US$800 to US$1,000 in the case of entirely new units, and US$350 to US$500 for modernization and expansion operations. 17/ Other estimates offered in the late 1970s, range as high as US$1,300 for new, large, integrated installations, and US$490 for steel made from the direct reduction/electric furnace. These figures reflect rapidly rising prices. In developing countries, the costs of integrated plant installation and expansion are even higher.

26. The capital required to establish a cement industry is less than that for steel but high in absolute terms for developing countries when the production units involved are large. Table 4 shows that in 1978 in India the investment per ton of installed cement making capacity was Rs. 741.25, or approximately US$75 for a 1,200 ton per day operation, and Rs. 597.29 or approximately US$60 for a 50 ton per day capacity plant. Thus, for a unit with a 400,000 annual output capacity, the minimum outlay required was US$ 30 millions. More recent information indicates a cost of US$125 million 1982 for a cement plant with a 750,000 t/year capacity set up near a port. 18/

Table 4

Minimum capital costs of production of cement, brick, and steel in developing countries

	Fixed Capital Investment	Working Capital	Total Investment
Bricks * ((US$1,000)			
Tunnel kiln **	2,086.0	95.0	2,182.0
Hoffmann kiln **	1,860.0	90.0	1,950.0
Cement *** (per ton in US$)			
400,000 tons/annum	71.0	3.1	74.1
16,500 tons/annum	55.8	3.9	59.7
Steel			
Integrated Units			2,000.0
5 mill. ton, Venezuelan, US$per ton			2,000.0
0.5 mill. ton, Algerian, US$per ton			
Semi-integrated			
100,000 tons, Paraguay, US$per ton			800.0

* 1975 dollars.
** Each plant has a daily output of 60 tons of perforated bricks, 2.5 kg weight (UNIDO, 1978).
*** Cement Research Institute of India, 1978.

Source: Moavenzadeh, Fred, "Global Prospects for Concrete Construction", Concrete International, February 1984.

V. THE QUESTION OF SCALE

27. In the last few decades, many developing countries seeking a path towards accelerated industrialization, have been favouring the import of the most modern technology available in industrialized countries, which tends to be large-scale and capital-intensive. Substantial capital investment, coupled with a strong belief in the benefits of economies of large scale, brought about the creation of large-scale enterprises throughout the developing world in the 1950s to the 1970s, which resulted in many cases in the under-utilization of production capacity, low productivity and low absorption of complex technological processes.

28. The above-mentioned experience, coupled with external constraints due to the increased indebtedness of developing countries and the increased costs of capital in the international financial markets, have led to a reassessment of the question of the benefits of large-scale over small-scale plants. Moreover, even where economies of scale exist in large-scale plants resulting in lower prices at the factory gate, they are very often offset by high transportation costs leading to high prices for the consumer.

29. In the building materials industry it has been established that the following main factors influence the choice of appropriate plant scale:

(a) Market size

The geographic size of the market base is determined, to a large extent by the availability of transport facilities. The manufacture of building materials requires large quantities of raw materials, and produces bulky and/or heavy goods. But the low value/weight ratio of many building materials renders transportation costs a more serious constraint than for virtually any other industry. Where transportation is difficult, as in mountainous terrain, or roads are poor or unpaved, transportation costs can be higher than production costs for certain goods. For example, in the Sudan, Honduras and Botswana, the transportation cost of cement over 100 miles exceeds its cost of production.

The constraint of transport cost varies inversely with the size of the consumer market for building materials. Were there are large enough markets to sustain economies of large-scale production within a reasonable distance of the manufacturing site, the constraint imposed by transport costs would be eliminated. However, a market limited by the absolute size, density, purchasing power or income of the population poses a serious constraint on the establishment and viability of large-scale building materials industries.

The market base expands and contracts in response to varying demand and the availability of transport. These changes call for a building materials industry able to adapt easily to varying conditions, and therefore flexible as to scales of production and possibly even portability of factories.

(b) Labour and capital availability

In developing countries, investment capital is scarce, while the supply of unskilled labour appears limitless. Under these circumstances, the import of technologies requiring large amounts of capital and offering few employment opportunities may constitute a poor utilization of factors of production.

(c) Skilled labour and management

Capital-intensive technology often reduces the need for unskilled labour, but it increases the requirement for workers skilled enough to run complex machinery. Finding sufficiently trained workers for this is often difficult. An increase in the scale of production normally entails a need for more materials, machinery and labour, which leads to the growth of the administration, and an increase in the need for supervisors and managers. Middle management is often scarce in developing countries and its lack may create serious bottlenecks in the organization of production.

(d) Technological complexity

An increase in technological complexity was intitially heralded as the means of maximizing the quantity of products made available to a country's population, and hence its social welfare. Yet a system that works efficiently in the industrialized world cannot simply be transferred to a developing country with similarly positive results. Technologically complex plants require auxiliary facilities often unavailable or extremely expensive in the developing world: sophisticated transport facilities, loading and unloading machinery, storage and distribution systems, warehousing for spare parts, large machine shops, etc. These additional facilities can increase overhead costs substantially.

30. Additional pitfalls may accompany the adaptation of complex, large-scale technologies to conditions in developing countries. Chief among them is the high possibility of a machine breakdown, particularly one that cannot be handled by a local repairman. A second problem is that plants are frequently operated at less than full capacity because market size may not warrant high production.

Minimum and maximum sizes of plants in the cement industry

31. The problem of the choice of plant scale can be illustrated by the case of the cement industry. The technology used in this industry seems to have undergone similar changes in developed countries as have other building materials industries like brickmaking, woodprocessing, steel production, etc.

32. Throughout this century the trend in the cement industry has been towards steadily increasing scales of production, and in the last decades towards automation. 19/ The average size of kilns installed during the 1970s was of 2,500 tons per day (tpd) and more recently a number of kilns with capacities over 4,000 tpd were installed. However, in some developed countries (such as the USA) the trend seems to be toward a system of smaller-scale cement plants. This seems to be due to a number of factors, such as pollution control regulations, high fuel prices which made transport of cement too expensive and favoured the installation of smaller scale plants close to various markets. This trend has been helped by the technological advances made in the design of small-scale plants, like e.g. improvements in design of the vertical kiln.

33. At the other end of the scale, plants producing cement at a scale of 50, 30, 20 and even 10 tpd have been produced in some developing countries as for

instance India and China. Finally, cementing materials can even be produced on a cottage-industry level. The difference between these two extremes is not just one of scale of production. The properties and uses of the materials made are different, as is the technology involved. But it is significant that there is active development work being carried out on different sized plants and it is becoming increasingly clear that there is no one "best" or "most appropriate" technology for the production of cement.

34. Apparent economies of scale in cement production can be substantial but in practice these economies of scale might not be realized in developing countries. Actual performance of large plants frequently fails to match forecasts and projections used in feasibility studies. Actual outputs of around 50 per cent of rated capacity are common, and total financial investment, plant operation sophistication and increased construction time all increase with expanding plant size. Another factor is that large-scale cement works have a very long start-up period. In fact, they do not begin to operate at full capacity until four to six years after construction.

35. Production in a few small plants could offer direct savings in transport costs coupled with more assurance of supply through a multiplicity of suppliers. Of course, dispersed production in small-scale plants would be possible only if the raw materials (mainly limestone and gypsum) are generally available. Fortunately these materials are widely available in most countries, and a further advantage of small plants is that they can usefully exploit small deposits of these materials. Another advantage of dispersed cement production associated with production in smaller plants is that easier availability of cheaper cement in rural areas is likely to promote construction of rural infrastructure and spread the benefits of development more evenly.

Points for discussion

36. The Consultation is invited to consider the following:

(i) What are the needs the building materials industry will have to satisfy in developing countries in the years to come? How can these needs be assessed and projected on an national, regional and interregional basis? Could a core list of building

materials required by developing countries be established? What are the constraints of developing countries to develop production of these building materials?

(ii) What measures could be adopted to improve planning for the development of the building materials industry? What is the role of international co-operation toward this end?

(iii) Is the question of scale relevant for the development of this sector? What are the possibilities and constraints of small-scale manufacture of building materials, and what measures could be taken to promote such small-scale plants?

Notes

1/ J.R. Riedel, Siegfried Schultz, "Construction and building materials industry in developing countries", Economics, 1980, Vol.21, p.40.

2/ Fred Moavenzadeh, Measures and actions to increase the production of indigenous building materials in the context of enhanced import substitution, UNIDO, ID/WG.425/3, 1984, p.14.

3/ ECE/FAO, European Timber Trends and Prospects 1950 to 2000, Geneva 1976, p.35.

4/ UNIDO, World-Wide Study on the Building Materials Industry (1985).

5/ ibid.

6/ Based on data from UN-Yearbook of National Account Statistics, 1981.

7/ ECA, Needs, constraints and prospects of African countries regarding the availability of building materials, 1983 (mimeo), p.2, paper presented at the Symposium on Appropriate Building Materials for Law Cost Housing in the African Region.

8/ UNCTAD, Tariff and non-tariff obstacles to international trade in building materials, Geneva, 1984 (mimeo).

9/ United Nations, World Population Trends and Policies, 1981.

10/ According to World Bank data of 1975, between 30 per cent and 80 per cent of the population living in large Third World cities (World Bank, Housing: Sector Policy Paper, Washington, 1975).

11/ See Issue Paper No.3, ID/WG.434/4, 1985.

12/ J.R. Riedel, Global Prospects for the Development of the Construction and Building Materials Industry, Munich 1983 (mimeo), p.29-36.

13/ UNIDO, World-Wide Study on the Building Materials Industry (1985).

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15/ J.R. Riedel, Long-term forecasting and planning of the construction and building materials industry, UNIDO, ID/WG.425/2, 1984.

16/ Plan Nacional de Desarollo Industrial (1979), México.

17/ Fred Moavenzadeh, ibid., p.24.

18/ Sid Boubekeur, Outline of a policy for mastering capital goods technology, UNIDO, ID/WG.424/4, 1984, p.27.

19/ UNIDO, Optimum scale production in developing countries, Sectoral Studies Series No.12, p.41-51.